# The Chemical Age

**A Weekly Journal Devoted to Industrial and Engineering Chemistry**

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# The Properties of Solids

IT is an interesting fact that the more tenuous matter may be, the easier is it to explain physically and mathematically its behaviour. The simplest case is the behaviour of a gas at very low pressures, where each atom or molecule moves with comparatively rare collisions and at constant velocity between the collisions. The most difficult to explain is the behaviour of solids where the atoms are packed closely, and this, perhaps, accounts for the relatively small volume of scientific work on this subject compared with that on gases. It was thus with particular interest that we heard Professor E. N. da C. Andrade deliver the James Forrest Lecture to the Institution of Civil Engineers on the "Mechanical Behaviour of Solids."

The lecture was concerned largely with the work that has been done in Professor Andrade's own laboratories, and some, at least, appears to be hitherto unpublished. The properties of a solid are to some extent determined by its prior history. Certain properties of ionic crystals, for example, are what are termed structure-sensitive, whereas specific heat is not. Among the structure-sensitive properties is the strength of the metal, as indicated, for instance, by the tensile force necessary to disrupt a bar of it. Professor Andrade's investigations have started from the very interesting fact that whereas theory indicates a high strength for solids, in practice the strength is a great deal less. When a solid is broken the effect is to produce two new surfaces, and from the calculations based upon the probable surface tension of the metals (liquids and solids are known to have surface tensions of the same order of magnitude) it can be shown that whereas a single crystal of rock-salt, for example, should have a strength of 20 kilobars, its actual strength is no more than 20 bars—1/1000 of this (one bar = $10^6$ dynes/cm.$^2$).

Many metals and many solids are crystalline or poly-crystalline in structure, and it might easily be suggested that this diminution of strength is due to weakness at the crystalline boundaries. The fact that this is not so is indicated by an experiment upon a single crystal of rock-salt. It was found by means of polarised light that rock-salt when under stress becomes distorted along certain planes. Immediately, attention is directed to the crystallographic planes, made so clear by the work of Bragg through X-ray analysis. It can be shown by taking X-ray photographs of a stressed and un unstressed crystal that crystalline distortion has occurred.

Other interesting evidence is offered by glass, which is not crystalline. A freshly-drawn fibre of glass is much stronger than the same fibre after standing a few days. A. A. Griffiths propounded the theory that the low actual strength of glass compared with its theoretical strength was due to the appearance of very small surface cracks, whose depth was of the order of one to two $\mu$. Professor Andrade has shown that this is so by his discovery that these cracks can be made evident by the attack of sodium vapour. As a practical illustration of the "chancy" way in which scientific discoveries are made, Professor Andrade mentioned that he was not looking for these cracks, but happened to notice them in the course of other experiments with sodium vapour conducted, with Mr. Tsien, for quite a different purpose. The important observation was further made that these surface cracks on annealed surfaces always met at right angles to each other, thus showing that they are due to the release of strain. The existence of surface cracks also explains the fact that rock-salt can be bent under warm water, although in air the crystals would break. It is bent because the surface layer containing the cracks is dissolved away so fast as the cracks are formed. A further experiment, due to Orowan, which supports the crack theory is that the normal strength of mica is 3 bars, but when the stress is applied in the centre of the mica so that the edges are not under strain, the strength increases to 32 bars.

By working with single crystals of metal, Professor Andrade and others have shown that glide occurs over a number of slip-planes several thousand molecules apart, this being evident in even the purest metals. The metal glides along the crystalline planes, and a remarkable series of photographs taken in Professor Andrade's laboratory, many representing single crystals of solid mercury, the purest metal procurable, showed the development of the slip of the metal along these planes.

The theoretical brittle rupture of a material may be 100,000 bars; in a poly-crystalline sample of this material it may be 1300 bars, whereas in a single crystal it may be only 20 bars. Professor Andrade has suggested that it may be possible to explain the anomalous behaviour of the single crystal and poly-crystalline specimens by the hypothesis that the poly-crystalline specimens are strong because the boundaries between the crystals are weak. This also enables him to explain why the stretching of metals greatly increases their strength. Circumstances prevent more than a very abbreviated account of Professor Andrade's lecture, but it is evident that he has been engaged upon work of the utmost importance, which will lead to a great increase in our knowledge of solids.

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# NOTES AND COMMENTS

### Vinylidene Chloride Resins

FOR some time past vinylidene chloride has been investigated in industrial research laboratories and it is now the subject of some forty patents. It is a clear, colourless liquid with a characteristic odour, and boils at 31.7° C. The liquid monomer may be polymerised in a long linear chain by direct linking of the monomer molecules to form an insoluble white crystalline powder. A wide range of properties may be obtained either by controlling the length of the chain or by using a copolymerising agent or both. Through a variation in the type and quantity of copolymerising agents an almost infinite number of resins having widely diversified properties may be obtained. They range from a flexible, moderately soluble material having a softening point about 70° C. to a hard, tough, thermoplastic solid with a softening point of at least 180° C. To a greater or lesser degree, these resins, known by the trade name of "Saran," exhibit crystallinity of structure. Several applications have already been noted. Saran has been used for railway and tramway seats, where it stands up to hard conditions of wear; it has also been incorporated in the bulkhead panels of air liners. Being a pure thermoplastic resinous bonding agent, it has become an essential ingredient in a new type of abrasive wheel. Promising applications, based on the material's extreme chemical resistance, include extruded tubing and other shapes as well as compression and injection moulded articles.

### Wholesale Prices in April

THE Board of Trade Index Number for wholesale prices of industrial materials and manufactures for the month of April is 154.3 (1930=100); for chemicals and oils the figure is 126.2; for iron and steel 181.0; and for non-ferrous materials 124.2. Compared with the March figures, that for chemicals and oils represents an increase of 0.6 per cent.; and that for iron and steel an increase of 0.1 per cent. For non-ferrous materials there was no appreciable change. In the past twelve months (that is, since April, 1939), the respective increases are 10.7, 18.5 and 1.0 per cent. The rise of approximately ½ per cent. in the chemicals and oils group was due to price increases in March which affected sulphuric acid and varnish. There was an increase of 2 per cent. in the monthly average price of tinplate, but no movements of any importance were recorded in the non-ferrous metals. The aggregate increase in the prices of industrial materials and manufactures since the outbreak of war is 51 per cent. and in comparison with March the rise was 0.2 per cent. A notable feature is that the prices embracing the whole range of articles covered by the Board of Trade monthly index number, were only 0.1 per cent. higher in April than in March, this increase being the smallest recorded in any month since the outbreak of war.

### Fatigue of Skilled Workers

SKILLED workers are of such prime importance in chemical and other factories engaged on war work that it is surprising that more concentrated study has not been devoted to the special problems affecting them. This week, however, the Royal Society's Ferrier Lecture, which was delivered on Thursday by Professor F. C. Bartlett, dealt specifically with "Fatigue Following Highly Skilled Work." As Professor Bartlett pointed out, almost all investigators on the subject of fatigue have merely adopted methods taken over with very slight change from those used in the study of simple muscular fatigue. Routine repetition of simple actions, however, is not a characteristic of any highly skilled work, and least of all of work having a strong "mental" component. The operations involved here are marked by complex, co-ordinated and accurately *timed* activities. The stimuli in response to which these activites are set up are neither simple nor do they usually fall into an order of fixed succession. It is possible to develop fully controlled experimental situations in which these realistic considerations have full play. When this is done the picture of fatigue following highly skilled work which emerges has certain strongly marked characters. In such fatigue the "standards" accepted and followed by the central nervous system unwittingly deteriorate. The operator tends to think that he is doing better work, because errors treated as significant all the time get wider and wider limits. Until a stage of great fatigue is reached, it is far more likely that the right actions will be performed at the wrong times than that the wrong actions will be performed. Stimuli in the margin of the pattern, not closely organised with the central field, are ignored, "forgotten," and serious lapses of specific reactions occur. Sensations of bodily origin become more pressing and insistent and affect the performance in ways peculiar to the tired operator. Side by side with all these changes go constant subjective symptoms. Verbal reports about failures of performance become increasingly inaccurate, and errors are regularly projected upon objective conditions, or attributed to the interference of other people. There is a tremendous growth of irritability.

### Smoke Abatement and National Defence

AN interesting dual-purpose appeal has just been launched, with "For the War Effort *and* for Reconstruction" as its keynote, by the National Smoke Abatement Society. Faced with the problem of an income diminished because of war conditions, and with the prospect of intensive work as soon as peace is restored and the work of reconstruction begins, the Society has started a "Defence Bond Fund" to help the national effort now and to aid the campaign for clean air in the future—in what is said may well be a period of "high hopes and low finances." All the contributions made to this fund will be immediately used for the purchase of Defence or other War Bonds, which will be retained, and the use of the money deferred, until the rebuilding of Britain begins. Some idea of what is possible in the reduction of smoke as a result of the new situation is given in the spring issue of *Smokeless Air*, the Society's journal, which publishes a first statement on the problem submitted to the Government departments concerned with reconstruction. It is declared that complete smokelessness is feasible in the rebuilding of central areas of business premises, and urges that an example should be set by the abolition of all smoke from Government and municipal premises. The problem of smoke and fumes is by no means foreign to the chemical industry and in this issue we publish an article dealing with the problem from the viewpoint of the chimney-stack designer.

# New Electrical Devices in the Chemical Industry

## The Electric Ear and the Electric Eye

by D. D. HOWAT, B.Sc., A.M.Inst.M.M., A.I.C., Ph.D.

IN cement manufacture and ceramics fine grinding is an expensive item in the production of the finished article. Close control of this operation will afford not only increased capacity, but a reduction in a heavy item of the cost sheet.

The sound made by the ball mill during grinding is most commonly used as indicative of the conditions in the interior of the mill, the operator guided by experience increasing or decreasing the solids and water feed until the sound issuing from the mill is "normal," representing optimum grinding efficiency. Obviously, the efficiency of grinding will depend very much on the extent of the operator's experience and initiative and the degree of attention that he pays to the performance of each individual unit. Grinding conditions cannot be rigidly standardised because of the variations in the character of the feed and fluctuations in the load together with actual changes in the interior of the mill due to wear of the crushing bodies and liners. Some automatic means of controlling the operation of the ball mill is almost essential if maximum grinding efficiency is to be obtained and conditions altered immediately to compensate for changes in the character and volume of the feed and the nature of the charge. The Hardinge Ball Mill Co., Inc., has carried out extensive experimental and research work along these lines, and a device, known as the "Electric Ear," has been patented, giving automatic control of the operation by means of the sound issuing from the ball mill.

Maximum sound will be produced inside a grinding mill when the balls or rods are striking freely against one another or against the liners, no cushion of any kind being interposed, and the entire energy being dissipated in the form of heat. If a complete cushion of finely ground material exists around the balls, the sound will be at a minimum, no useful grinding being accomplished as the mill is overloaded. Between these two extremes there will be a stage at which just sufficient solid material occurs between the balls to ensure that large particles are fractured and broken but not overground. The sound produced under these conditions should indicate the optimum grinding efficiency. The approximate relation between useful work done in grinding and the relative noise level of the mill is indicated in Fig. 1.

In open-circuit grinding the size of feed, the discharge, and the rate of flow of material through the mill all affect the sound level. If the size of feed increases, the spacing between the balls is increased and the sound level alters. If the feed size remains constant but a different fineness is required, the sound level will vary, a mill producing a fine product being louder in operation than one producing a more granular discharge. Where a mill is operating in closed circuit with a classifier conditions are rather different, the rate at which the material passes through the mill being an important factor. The sound level may be maintained approximately constant, but the fineness of the discharge varied by increasing or decreasing the circulating load. Again, the fineness may be constant, but the sound level varied by varying the circulating load. The use of sound to control the operation of the mill is therefore a much more intricate problem in closed-circuit than in open-circuit grinding.

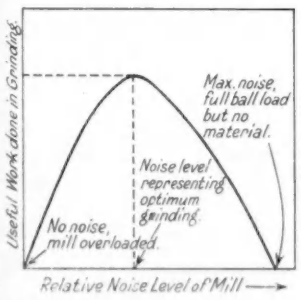
Useful Work done in Grinding.
Max. noise, full ball load but no material.
Noise level representing optimum grinding.
No noise, mill overloaded.
Relative Noise Level of Mill

**Fig. 1. Relation between noise level in mill and useful work done in grinding. (Hardinge.)**

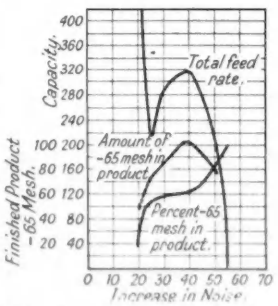


**Fig. 2. Relation of noise level to total feed rate, amount of finished product available, and fineness in mill grinding in open circuit. (Hardinge.)**

### Duties of Sound-Control Device

An analysis of the sound frequencies from mills operating under different conditions showed that no particular frequency occurred that could be used to distinguish one load condition from another. By using a method of sound pick-up with highest sensitivity in the middle frequency range a quantitative measurement of sound intensity could be obtained without involving faulty operation due to variations in frequency. Investigation of actual conditions proved that a device to control the operation of a grinding circuit by sound must fulfil the following conditions to be a practical proposition:

(a) Produce a higher degree of efficiency than manual control;
(b) Control automatically the rate of feed or other factors that affect the operation of the grinding circuit;
(c) Be mechanically robust and reliable;
(d) Be equipped with means of regulating the grinding circuit under all ordinary conditions; and
(e) Be able to control the noise level of the mill within much closer limits than is possible with manual control.

As finally developed by the Hardinge Company, the Electric Ear comprises a microphone and a cabinet containing the electrical control circuit and the operating control panel. Enclosed in a box, the back of which is a sound-proof housing and the front a dust-proof fabric covering, the microphone is situated at the focal point of a parabolic reflecting shield. This design increases the intensity of the sound pick-up, eliminating extraneous noises from plant in the vicinity. The microphone box is placed close to the grinding mill about the level at which the balls strike the lining during grinding. The sound energy from the microphone operates through the electrical equipment and power relays in the control panel, stopping or starting the motor driving the grinding mill feeder, a "time delay" circuit being fitted to prevent fluttering should excessive fluctuation occur in the sound level at short intervals.

The sound energy picked up by the microphone is measured in microamps, the actual current generated being dependent on the sound level from the mill. When the current from the microphone exceeds a certain fixed value the relay circuit controlling the feeder motor is energised, fresh material passing into the mill to re-establish optimum grinding conditions. When the sound level fails to generate this critical current, indicating a very slight overload in the mill, the relay circuit is cut out, the feed motor stopping.

Emphasis must be placed on the fact that the Electric Ear may be used only in conjunction with a mechanically operated mill feeder driven by an electric motor. The sensitive control circuit inside the cabinet, operating at one current intensity only, in turn operates the power switch controlling the feeder motor. The general design employs a simple "on and off" circuit, obviating any necessity for a variable speed drive or a slow and fast motor. During normal grinding operations the feeder motor experiences short "off" periods lasting 2 to 20 seconds, and longer "on" periods extending up to 60 seconds. Experiments have shown that, under these conditions, the variation in the microphone current is not more than ±2 microamps. Very close control of the grind-

ing operation is thus obtained, the mill never becoming overloaded or underloaded. Much greater grinding efficiency is claimed to be thus obtained than is possible even with the most skilful and conscientious manual control.

In installing the device, the microphone is coupled up merely as a sound recorder and the variations in the current produced are observed. Even with very skilful manual control the current generated may vary over a range of 20/30 microamps. The sound level associated with most efficient grinding will be somewhere within this range. The sound level indicator is set at some arbitrary point within the indicated range and the results observed over a period, the process being repeated until the reading indicating maximum grinding efficiency is obtained. Only accurate tests on the tonnage passing through the mill and on the size-analysis of the discharge product will reveal when maximum efficiency has been attained. The curves in Fig. 2 indicate the relation between noise level, total feed rate, amount of finished product, and fineness in a mill grinding in open circuit. Once the critical sound level and its characteristic current have been found, the sound level indicator on the control panel is set to the indicated value, requiring no further adjustment provided the grade of ore remains constant.

The relation between sound level and capacity at a given discharge fineness is indicated in Fig. 3. The very sharp rise to maximum capacity in the vicinity of the critical sound level is clearly shown. For the successful application of the Electric Ear, the critical sound level must be accurately

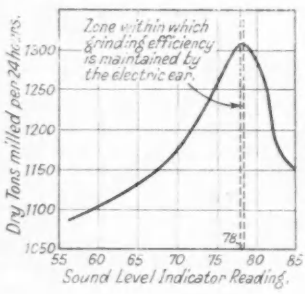


**Fig. 3. Relation of noise level to capacity at a given fineness. Note radical increase in capacity near optimum sound level. (Hardinge.)**

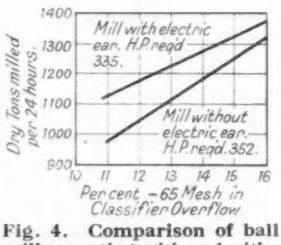


**Fig. 4. Comparison of ball mill operating with and without electric-ear control. (Hardinge.)**

determined and, further, the device itself must be capable of operating within variations in the sound level much smaller than can be detected by the human ear. Tests have shown that the Electric Ear will operate successfully within a range of ±2 microamps, while, as already indicated, the range even with very skilful manual control is 20/30 microamps.

Extensive tests on the Electric Ear were carried out at the International Nickel Company's Mill, Copper Cliff, Ont. A peripheral discharge mill, 6 ft. 6 in. diameter and 12 ft. 6 in. long, running at 23.1 r.p.m. and operating in closed circuit with a Dorr F.X. classifier, was used for the tests. With feed all passing through a $\frac{3}{16}$ in. screen 1182 tons were ground per day, 14.82 per cent. of the discharge remaining on a 65-mesh screen. When the microphone of the Electric Ear was coupled up as a sound recorder, the variation in the sound level with manual control was approximately 12 microamps. The usual trial-and-error investigations showed that the critical sound level was 78 microamps. Operating with the Electric Ear at this setting the tonnage ground per day was increased to 1304, 14.98 per cent. of the product remaining on a 65-mesh screen. The power consumption in the mill was 4.60 kWh per dry ton treated with a circulating load of 340 per cent. The test results are shown in Fig. 4; the upper curve indicates the performance with the mill controlled by the Electric Ear set at 78, while the lower curve is the performance of the mill with ordinary manual control. Grinding to 87.5 per cent. −65-mesh an improvement of 120 tons per day, or 11 per cent., has been attained.

Nordberg gives brief accounts of the application of the Electric Ear to grinding in the cement industry. In the North American Cement Corporation plant at Security, Md.,

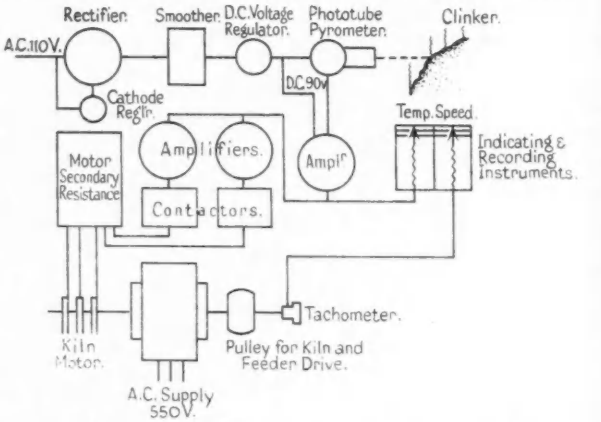


**Fig. 5. Schematic diagram of connections for tubes and auxiliaries in temperature control through kiln speed (Rogers.)**

the device is used to control the grinding of the raw material before feeding to the kiln. The kiln feed is ground in a Hardinge Mill 66 in. by 10 ft., driven at 17.7 r.p.m., by a 400 h.p. super-synchronous motor. The Electric Ear is in circuit with a 2C Hardinge constant weight feeder driven by a $\frac{1}{4}$ h.p. motor. The discharge from the mill, 99.9 per cent. −100-mesh, is produced at the rate of 25 tons per hour. The ball mill discharge is found to vary not more than 20 per cent. over long periods so that a reasonably steady feed to the kiln is maintained. Under normal conditions the feeder motor is "on" for periods of about one minute and "off" for about ten seconds. Grinding costs have also been reduced at Silica, Ohio, where the Medusa Portland Cement Co. employs the Electric Ear to control the feed to the clinker grinding ball mill. The mill in use, 7 ft. by 22 ft., was formerly a compartment mill, but has been converted to a ball mill with double-end feed and central discharge. The mill operates in closed circuit with six 5 ft. by 4 ft. 20-mesh screens, about 150 barrels of −20-mesh clinker being produced per hour.

The Electric Ear has also proved its usefulness in controlling the grinding of soft friable talc ores. At the mill operated by the Eastern Magnesia Talc Company Inc., Johnson, Vt., the −½ in. crude ore is crushed in a 36 in. by 8 ft. Hardinge mill. The mill is driven at 27 r.p.m. by a 75 h.p. motor through a link belt silent chain drive, the ratchet type rotary feeder being controlled by the Electric Ear. The feed rate is about 2½ tons per hour. The discharge passes to a 7 ft. Raymond air separator, about 50 per cent. being recovered as a commercial grade talc, the average particle size of which is under 10 microns.

## The Electric Eye

Burning the mixture of raw materials to a clinker in a suitable kiln is a key operation in the production of cement. The higher the grade of cement called for and the more exacting the specification, the greater is the importance of clinker formation. A horizontal rotating kiln has been used for this operation, the movement of the kiln assisting in the thorough mixing of the charge and bringing the particles into contact with the intensely hot flame from the burner.

Assuming a constant flame temperature from the burner, the speed of the kiln is directly related to the amount of material passing through and to the temperature which the charge attains. Extensive tests and long experience indicate the most suitable burning temperature for any given grade of cement clinker. A first essential for the production of clinker of constant grade and uniform properties is to ensure that the charge uniformly attains this correct kiln temperature. Controlling the temperature of the charge through the kiln speed appears to offer the easiest solution to the problem. A con-

trol circuit, designed by the G.E.C. and described by R. H. Rogers, utilises a phototube pyrometer with suitable electric relay circuits connected to the kiln driving motor. This apparatus has been patented under the title of the "Electric Eye." The diagram of connections for the phototube and auxiliaries to control the temperature through the kiln speed is shown in Fig. 5. A brief description of the systems follows.

The motors driving the kiln are of the wound-rotor (slip-ring) type, so that speed control is by secondary resistance, the necessary adjustments being effected by contactors which cut out in two stages about 20 per cent. of the total resistance employed. The control equipment, as shown in the diagram, consists of a rectifier, a smoother, and a D.C. voltage regulator, together with the photoelectric tube. The control equipment is supplied at 110 volts with alternating current which is rectified in a single tube with two anodes. To compensate for any variation in the electrical supply a regulating tube holds the voltage constant on the cathode circuit so that the electronic emission is constant. The D.C. output of the rectifier is controlled at 90 volts by the second regulating tube, offsetting any variations in voltage impressed on the rectifier tube anodes.

### The Lens System

The D.C. supply at 90 volts, after passing through a smoothing reactor, is impressed on the phototube. Fitted in front of the phototube is a lens system which is focused on the edge of the clinker cascade as it emerges from actual contact with the flame. The current passed by the phototube is proportional to the intensity of the light received by the lens system. A resistance is connected in series with the phototube, variations in the current passed by the tube causing variations in the voltage drop across this resistance. Introduced into the circuit at this point is an amplifying tube, across the grid of which the 90 volt D.C. supply is impressed, and which multiplies the phototube current by one-thousand. The grid of the amplifier is connected to the phototube resistor, acting as a damper on the flow of the current. The increased current supply has two functions: first, to indicate and record the temperature in the kiln as measured by the phototube; second, to act upon the grids of power valves which pass a current sufficiently high to operate the contactors on the secondary resistance in series with the rotors on the kiln motors. On the spindle of the kiln motor are the pulleys driving the kiln, the raw material feeder, and a small tachometer generator the output from which actuates the speed indicator and recorder. Charge is fed to the kiln by a dry-screw feeder driven by sprocket and chain from the kiln motor shaft, any change in the speed of the kiln motor being automatically reflected in the feed. The fuel, air, and draught are under independent manual control. On starting up, the normal drum switch control is used. Once the operation is under way and the temperature up, the control circuit is switched in and the kiln speed regulated by the temperature.

### Applications of the Electric Eye

The Electric Eye has been used by the Lehigh Portland Cement Co., being fitted to ten kilns in the plant at Fogelsville, Penna. Four additional installations have also been employed at the cement mill at Alsen, N.Y. A recent application of the Electric Eye at the Nashville plant of the Victor Chemical Co. has given promise of greater developments of this device in the control of chemical processes generally. The Victor Chemical Co. produces elementary phosphorus by smelting phosphate rock in blast or electric furnaces. The gases and vapours escaping from the furnaces are burned, giving among other products phosphorus pentoxide which is absorbed in a hydrator yielding a solution of high phosphoric acid concentration. This solution is allowed to react with suitable alkali, the salt produced being ignited in a rotating kiln. The aim of the operation is to produce tetra-sodium pyrophosphate which, having a high content of available phosphorus pentoxide, is a valuable fertiliser. To ensure maximum production of this salt and minimum loss of phosphorus pentoxide by volatilisation, the temperature in the kiln must be very closely controlled. The Electric Eye fitted to this kiln is claimed to have given very satisfactory results in the production of the salt.

To say that these devices give complete control of grinding and burning operations would be a considerable overstatement. They do, however, open up interesting lines of approach to the solution of problems with which the industrial chemist must always be concerned. If the claims made for them are substantiated they will render easier the production of substances of more even grade and composition, allowing greater capacity from existing units together with decreased production costs.


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# A.S.W. Council Meeting

## War-time Difficulties Surveyed

THE annual Council meeting of the Association of Scientific Workers, held in Birmingham on May 24 and 25, was the first Council meeting since the registration of the Association as a trade union. The reports presented and the ensuing discussion were chiefly concerned with the planning of an industrial policy for the Association which would offer a solution, through trade union activity, to the immediate problems of scientific and technical staff.

A report by the Industrial Sub-Committee of the Association showed that there was a considerable difference between salaries paid to people having the same qualifications, but employed by different firms. In the engineering industry, for example, the general salary level was notably less than in certain chemical firms.

Because of war-time restrictions on change of employment, the power of the individual to obtain increments was seriously depleted, his chief bargaining instrument having been his ability to seek alternative employment. A survey amongst members had shown that there was a marked tendency in industry for no increments to be given, while in Government establishments war-time posts carried a fixed salary. It was pointed out that cancellation of increments was particularly unfair to the younger scientists whose salaries were frozen at the low starting figure. An example was cited of an honours graduate in physics whose salary was initially fixed at £170 per annum, while representations to his employer had resulted in an increase to only £215. Since the University Joint Recruiting Boards restricted the type of firm in which a post could be sought on graduation, the individual had now in effect to accept a post irrespective of the salary offered.

Failure to grant payment for overtime to many scientists and engineers was likewise cited as a source of injustice. Whereas foremen in a certain chemical works, for example, were receiving £7 10s. per week including overtime payments, the plant chemist, who supervised them, received only his basic salary of £6 per week for the same number of hours of work. Other matters brought up for examination included the sudden alteration of hours of work and holidays, and it was concluded that collective action through the Association was now proved to be the only effective method by which engineers and scientists could safeguard their conditions, and bring them into correct relationship with those of organised sections of industry. The Council unanimously adopted a resolution in favour of close co-operation between the A.S.W. and other trade unions.

# Brick Chimneys for Chemical Works

## Precautions Against Acid Attack

by P. MORRIS

CHIMNEYS are called upon to perform many duties other than the comparatively simple one of producing draught for steam boilers. To chimney designers and constructors, these duties present many problems, such as the determination of the proper height, the size and other details of design, particularly in chemical works, dyehouses, smelters, paint works, plating plants, sintering plants, and celluloid works, all of which have to contend with the bogy of acid attack. Many of the gases generated are destructive to ordinary brick and mortar, steel, concrete, and tile. Some are destructive at certain temperatures and innocuous at others; some are harmful under certain conditions of humidity and harmless at others. The designer of chimneys for works of this type must, therefore, not only be a mathematician and mechanical engineer, but must also have a knowledge of chemistry, thermodynamics, and ceramics, and be familiar not only with the flow of gases but with the effect on a chimney of different kinds of acid gases, under varying degrees of concentration, moisture, and temperature.

Many of the chimneys used in works of this type are not employed in connection with steam boilers, but are connected directly with roasting kilns, furnaces, and other plant where acid gases are generated. A chimney to handle noxious and acid gases must be designed and built not only for adequate capacity and draught, but also to resist the destructive effect of the gases involved, as well as to withstand the dynamic wind forces that tend to fell it. The smoke streams emitted from such chimneys contain acid in both liquid and gaseous form, which are often a nuisance to the community; some are detrimental to vegetable and animal life, according to the concentration of harmful components.

### Removal of Acid Gases

Works of this nature are faced with the disposition of these gases. Among the methods used to remove acid gases and flue dust from the smoke are washing in scrubbing towers, the use of sprays, baffle chambers, bag houses for filtration, and electrical precipitators, all of which are successful in varying degree in reducing the fume and dust content. None so far has entirely succeeded in removing the objectionable elements before they enter the chimney. Some of the methods enumerated above tend to reduce the stack temperatures materially. Some contribute moisture to the gas stream and increase the acid mist, and thus add to the undesirable activity of the dust and fumes.

Chimneys from 350 to nearly 600 ft. in height, discharging the gases high above the surrounding country, where they become diffused and diluted before reaching the earth, are not unusual. They may not serve their purpose perfectly, but their continued use is evidence that the results are not entirely unsatisfactory.

In chemical or industrial works where the fumes are not acid or noxious, but yet are disagreeable in odour, the gases are easily disposed of by means of a comparatively tall chimney. As the smoke stream has no destructive content, no precautions need be taken against acid action. The fumes are carried to an altitude where their diffusion in the atmosphere greatly reduces any objectionable odours, even if it does not entirely eliminate them. The fine dust coming from roasting kilns or horizontal rotary kilns in the burning of lime or pyrites, or in sintering processes, may be well diffused by releasing the dust stream at a high altitude.

Of the many gases generated by the chemical industries, such as those of the sulphur, nitric, chlorine, fluorine, lead, and arsenic groups, the sulphur group is the most frequently encountered. Those of the carbon family give little concern, as they are not particularly detrimental to the community nor do they tend to disintegrate a brick stack.

Sulphur trioxide, sulphur dioxide, compounds of lead, and arsenious oxide are noxious and objectionable. The first of these attack to a marked degree common brick and ordinary mortar, concrete and steel, and cannot be discharged safely through the ordinary chimney designed for use in connection with steam boilers burning coal. Sulphur dioxide gas in the pure state will condense to a liquid at about $-10^{\circ}$ C. Above this temperature it remains a gas and will not combine to form a damp acid mist nor liquid acid. If present in small quantities in the smoke stream at atmospheric pressure the condensation point is much lower. This particular gas, therefore, has little or no effect on a brick chimney. At present it is only necessary to dilute the sulphur dioxide content of the smoke stream so that it will be harmless when it reaches the ground. This is being done through the use of tall chimneys safeguarded against the corrosive action of the gases by means of auxiliary furnaces to raise the temperatures. This is the general practice among the more advanced smelting and refining companies. Unlike sulphur dioxide, sulphur trioxide, even in low concentrations, will combine with the water vapour of the smoke screen and form a fog of sulphuric acid on the walls of the chimney. Of that which passes out of the chimney, some may eventually settle to the ground in the form of mist or dew, but the amount in any properly designed and constructed plant is too small to cause any trouble.

It is obvious that the temperatures at which an acid gas will become an acid liquid depend upon the concentration of water vapour and acid gases in the smoke stream. The greater the concentration of sulphur trioxide and water vapour the higher the temperature at which the condensation will take place. Unfortunately, the sulphur gases tend to be rather dilute and in the presence of moisture are more active than a more concentrated gas would be. As long as they remain gaseous they have little effect upon hard-burned impervious brick and commercial acid-proof mortar. Some authorities give the condensation point of the sulphur trioxide under the above conditions as low as $135^{\circ}$ C., but the best practice is to maintain temperature of the smoke stream at $200^{\circ}$ C. or over.

### Chlorine and Nitrous Oxide

The fumes of chlorine and nitrous oxide under certain conditions attack common brick and mortar, concrete, unvitrified tile, steel, and the common metals. The effect of these materials, particularly in the presence of moisture and low temperatures, is practically the same as the effect of sulphur trioxide. A structure to stand up against them should follow the same general design and use of materials as one built to resist the action of sulphuric acid. Dispersal of chlorine and nitrous oxide fumes at high altitudes is common practice. Here, too, if the products of combustion carrying these two gases have a low temperature, auxiliary furnaces are employed to raise the temperature. This gives added velocity to the smoke stream, decreases its density, and causes it to rise considerably above the top of the chimney. Diffusion in the atmosphere is thus more completely accomplished.

The most important point in handling acid gases in a chimney is to maintain a high internal temperature. This often destroys the detrimental effect of the gases on the masonry. Further, the higher the temperatures of the released gases at the top of the stack, the higher the fumes and acid mist will ascend, and the greater their dilution before reaching the ground. This is a most important point in smelters and chemical plants, particularly where sulphur dioxide has to be dealt with.

A wet or damp acid smoke stream in contact with ordinary mortars made of cement, lime and sand, or sand and cement,

or with certain commercial mortars which do not contain cement and lime, produces a swelling and puffing of both the bed and cross joints accompanied by a tremendous pressure. The swelling amounts at times to 25 or 30 per cent. A chemical change takes place at first on the surface. The mortar becomes soft and of the consistency of mud. As time goes on this softening and swelling works through the walls, causing the brickwork to bulge and crack. Steel bands are useless, even on the outside, for the masonry will bulge between the bands, and in time the bands will give way. If the temperatures are raised or the chimney dries out, the inner parts of the joints may become hardened but still remain swollen. If the brick is not hard and impervious, the exposed part becomes soft and flakes off. This process is continuous until the whole brickwork is changed into a soft mass.

## Vertical Cracks

Instances have been observed where the swelling of the joints is uniform in the circumference of the chimney and irregular bulging of the structure is hardly discernible. The disintegration takes the form of vertical cracks. These usually appear first at the top where the walls are thinnest, and in time they work downwards to the base. Vertical cracks are due to the swelling of the joints, causing circumferential strains as the diameter tends to increase. These strains are greater than the strength of the masonry. It is further observed that the cracks increase more rapidly on the windward or weather side. This is to be expected, for on that side the rain and snow are driven more frequently and more forcibly against the surface and into the interior of the initial small cracks. The water accelerates the disintegration of the acid-soaked joint; and once the joints are soaked with acid, the swelling will continue as long as they can take up any moisture, and by capillary action this continues to spread through large areas.

Even if the acid fumes are comparatively dry, certain of them will attack the mortar, and destroy the cement or any binder that contains an element which will combine with the acid fumes, turning the joint into a weak, sandy mass. Bricks not vitrified and impervious share the same fate. The effect on concrete is a rapid disintegration of the whole mass due to the breaking up of the cement content and to the acid action on certain aggregates.

Acid action has been observed from the smoke stream resulting from the burning of certain oils under boilers. This is particularly in evidence where the sulphur content of the oil is high and steam atomising burners are used. In the installation, especially in connection with economisers resulting in low flue temperatures, and when the chimneys are high, the protection of the upper portion should have the attention of an expert. This depends entirely upon the sulphur content of the oil, and the smoke of many fuel oils has no effect whatever upon the brick lining of chimneys designed for coal-burning steam boilers.

## A Chimney Within a Chimney

In designing a chimney for acid duty it is necessary to give protection to the main walls by an independent lining for the full height of the structure, with ample air space between it and the main walls. An air space of not less than 3 or 4 in. at any point is recommended. The design is, in fact, a chimney within a chimney. Such an inner lining must be built of impervious, practically vitrified, brick, very low in lime and laid up in acid-proof mortar. This mortar must be capable of resisting the particular acid to be contended with; obviously no one mortar will suit every job. The thinnest possible joint is imperative. The bricks must be thinly buttered or dipped and struck tightly into place.

Many acid-proof mortars are proof against certain acids as long as the gases are dry and at comparatively high temperature. These mortars are often composed of a mixture of pure clay, silica sand, kaolin, asbestos fibre, china clay, graphite products, ground gypsum, and the like. A common binder is silicate of soda. These mixtures cannot be claimed as being always acid-proof and they have been known to break up under the action of moisture. The mortar must be moisture-proof as well, and some of the best results seen by the author have been where pure silica sand only has been used.

The top of the chimney should be protected with a cap covering both the lining and main walls, and made of material not affected by the particular kind of acid under consideration. Ample room should be allowed for the lining to expand outwards and upwards. The cap must also be designed so that no dust, fumes, or moisture can find their way down between the main walls and the lining. With certain acids the cap may be made of lead. On the other hand, certain other acids will affect lead, though they will not necessarily disintegrate it, but cause it to buckle. With other acid conditions a cap of Monel metal has been used with success, and other alloys have from time to time been very successfully employed.

The gases coming from the top of a chimney are often blown down outside for distances varying from 25 to 100 ft. For that reason the same acid-proof mortar used in the lining should be used on the outside joints of the upper parts of the main walls. As this surface is exposed, it is essential that the mortar be weather-proof. Common building lime should never be used in any part of the structure.

In some chimneys where the temperature of the acid smoke stream is continually high and the acids not very active, the same brick and mortar may be used and a sectional lining constructed in place of an independent lining. This form of construction is less expensive. The corbels built out at intervals from the main walls and supporting the lining should have the inner joints pointed with acid-proof mortar. On the top of each corbel an acid-proof material should be set in such a manner that the lower lip projects down over the top of the section of lining below. The air space is then protected. In addition to this the upper 12 in. or so of the air space under each corbel should be packed with flexible material not affected by the particular acid dealt with.

## Lightning Rods

Where lightning rods are installed on acid chimneys, at least the upper 50 ft. of the rod should be sheathed to protect the copper from the effects of the acid. Lead covering is in most cases satisfactory. All chimneys handling acid gases should be equipped with an outside ladder, the upper part of which should be covered with lead or other acid-resisting material. Chimneys that have been in almost continuous service for years without showing any affect from the smoke stream have been observed to develop defects, particularly near the top, after they have been shut down for a long period.

Although the conditions of temperature, dilution, acid mixture and the like may be such as not to cause damage while the chimney is working, yet an accumulation of dust on the inner walls, which is deliquescent by virtue of its acid content, may tend to do damage while the chimney is disused. The weather—rain, fog, snow, or heavy humid atmosphere—supplies the necessary water inside the chimney to convert the previously inert dust with an acid content into a liquid acid which immediately becomes active. It is good practice, therefore, when the chimney is out of use to cover the entire opening at the top with a weather-proof lid. This can be made of suitably covered wood, which can easily be set in position and removed when necessary.

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GERMANY IS CONDUCTING extensive research for the processing of grapeseeds for producing grapeseed oil, according to Press reports. The oil is used as a substitute for linseed and olive oils in the manufacture of paints, lacquers, and soaps. Output has advanced during recent years with the installation of additional processing machinery. Future production of grapeseed oil is expected to reach 1500 metric tons. In utilising grapeseeds as a source of oil, Germany is following the example of other leading wine-producing countries in Europe. Italy, it is reported, will soon have a production of some 10,000 metric tons of oil annually from grapeseeds, and Spanish production will shortly attain about 5000 metric tons annually.

## NOTES FROM AMERICA

# Potash in the United States

### Increased Production in 1940

PRODUCTION in the United States in 1940 of 658,249 short tons of processed or refined potash salts, containing approximately 379,679 tons of $K_2O$ is shown by reports of producers to the Bureau of Mines. This represents a gain over 1939 of 20 per cent. in material produced and about 22 per cent. in $K_2O$. Sales of potash salts by the producers amounted to 677,892 tons, an increase of 7 per cent. over 1939, and contained about 393,058 tons of $K_2O$. The average $K_2O$ content of the salts sold was slightly higher in 1940 (57.98 per cent.) than in 1939 (57.77 per cent.) with the increase a little more than 7 per cent. The value of the sales amounted to $12,562,050 or about 4 per cent. more than in 1939. Processed stocks held by producers amounted to about 35,000 tons, containing 16,000 tons of $K_2O$; stocks of crude mined material held were 37,000 tons, containing 8000 tons of $K_2O$. The principal processed or refined salts produced in 1940 were manure salts, muriate, and sulphate. There was produced commercially in 1940, for the first time in the United States from domestic ores, sulphate of potash-magnesia, which has been regarded as indispensable to the fertiliser industry of this country and hitherto supplied by importations not now available. The production of sulphate of potash has increased noticeably in the last two years as has the production of high-grade muriate for the manufacture of chemicals.

Operations near Carlsbad, New Mexico, which now furnish the largest part of the potash materials, are carried on by the Potash Co. of America, United States Potash Co., Inc., and by the Union Potash and Chemical Co., which operated commercially for the first time in 1940. The latter company produces langbeinite from which the sulphate of potash-magnesia is made. Sylvinite is also produced at this mine. The total crude ore mined in the Carlsbad region in 1940 was over 1,200,000 tons, and the refined and processed salts produced amounted to over 440,000 tons. An important production of potash salts is from the saline deposits at Trona, California, by the American Potash and Chemical Corporation, where they are obtained as co-product with borax, sodium carbonates, sodium sulphate, lithium compounds, and bromine. There is also a production of potash from saline deposits at Wendover, Utah, by Bonneville, Ltd.

Imports of potash increased 18.5 per cent. to 289,037 tons of fertiliser and chemical salts, containing about 118,690 tons of $K_2O$. Although this represents an increase over 1939, it is less than one-third of the quantity imported in 1937. Only a few thousand tons were received from Germany, Belgium, and the Netherlands, but cargoes from France continued to arrive until about the middle of June and accounted for two-thirds of the gross tonnage entered at American ports. Shipments of muriate from Spain beginning in July amounted to more than 25,000 tons and Chile supplied about 50,000 tons of sodium-potassium nitrate.

# Trade in Synthetic Organics

### Export of Coal-Tar Chemicals Doubled in 1940

A LARGE surplus of the domestic output of synthetic organic chemicals of the United States is available for export, and the demand for American dyes and other coal-tar products increased sharply during 1940 as a result of the exclusion of Germany from most of the world markets. The value for exports of the coal-tar group totalled $28,448,691 in 1940 compared with $14,484,246 in 1939. An approximation of the 1940 export value of the non-coal-tar synthetic organic chemicals is $19,000,000 as against $13,000,000. Only products coming strictly within this category were taken into account. Unfortunately, separate classifications are not given in the foreign trade statistics of the Unied States except in the case of the coal-tar group.

Outbound shipments of coal-tar crudes in 1940 increased 23 per cent. in value to $5,348,559 from $4,339,697 in the previous year; shipments of intermediates more than doubled to 84,905,817 from $1,765,209, as did also finished coal-tar products to $18,134,315 from $8,379,340. Toluol, at $3,209,725, constituted the largest item among the crudes and was exported chiefly to Canada, United Kingdom, France, Sweden, Italy, and Japan, 1940 being the first year in which it was recorded. Among the coal-tar intermediates shipped abroad, phenol increased in 1940 to 4,304,357 lb. valued at $569,589, from 2,058,398 lb. at $281,299 in 1939; shipments went principally to the United Kingdom, Australia, Belgium, Finland, and Brazil. Exports of other intermediates, including coal-tar acids, increased according to figures in *Foreign Commerce Weekly* (1941, 3, 4 pp. 160-162) to 19,278,641 lb. at $4,396,288 from 7,388,903 lb., valued at $1,483,910.

Dyes of coal-tar origin were an important item in the exports for the year of finished coal-tar products, increasing to 24,399,521 lb., invoiced at $15,209,164, from 13,715,680 lb. at $6,432,358. During 1940, United States dyes were shipped to 76 world markets, the most important being British India, Canada, United Kingdom, Mexico, China and Argentina, while shipments of rubber-compounding agents of coal-tar derivation aggregating 2,737,023 lb. valued at $1,294,545 went chiefly to Canada and the United Kingdom.

Increases among non-coal-tar chemicals were most evident in exports of organic alcohols, aldehydes, and acids. In the alcohol group, all members for which data are available, including glycerin, but excluding butyl alcohol, showed increased exports; shipments of the group amounted to 85,802,397 compared with $4,092,170. Exports of other alcohols constituted a large sub-group and were destined chiefly to Canada, the United Kingdom, Japan, and Argentina. The organic-acid group increased to 17,634,804 lb. valued at $2,977,705, from 5,530,993 lb. valued at $759,834 in 1939. Included within this category were shipments of acetic acid, chiefly to China, British Malaya, and Argentina. Similarly, exports in the aldehyde and ketone classes (formaldehyde and acetone) increased, as did those in the ester class. Formaldehyde exports, mainly to Canada, China, and Argentina, totalled 5,709,520 lb., valued at $281,136, and shipments of acetone totalled 26,150,288 lb. valued at $1,947,414. These went mainly to the United Kingdom, Australia, and Japan, while butyl acetate exports rose to 6,318,685 lb. (value $584,550), going mostly to Japan, Australia, and Canada.

Rubber-compounding agents of non-coal-tar origin, synthetic collecting reagents, plastics, and industrial explosives maintained increases both in volume and value. Exports of plastics, for example, increased in value to $13,684,717, as against $10,224,918 in 1939. Synthetic resins accounted for $4,252,984 of this, and went principally to Canada, the United Kingdom, and Argentina. Exports of industrial explosives reached $20,868,274, compared with $4,998,865, and went principally to Latin America.

### Imports Show Decrease

Imports of synthetic organic chemicals generally declined from the totals of the preceding year. The coal-tar group at $9,029,043 was only half the value for that of 1939. Of this the United Kingdom and Japan supplied 97 per cent. of the largest single item among the crudes—creosote oil; 39,009,788 gal., at $3,889,528. Intermediates totalled 832,508 lb., valued at $862,611, a considerable drop on the value for 1939.

In the non-coal-tar group, imports of acetic acid increased to 1,821,638 lb. valued at $74,202, from 1,438,956 lb. Incoming shipments consist almost entirely of the grade containing more than 65 per cent. of the acid, and originated principally in Canada. Imports of synthetic camphor ceased entirely, and receipts of the natural variety fell to a value of $487,509 from $652,419 in 1939.

During the present period of progressive development in the synthetic organic chemical industry, production in almost every line has been accelerated by expansion of plants already established and through the erection of new plants. The decline in imports of synthetic organics in 1940 was due largely to increased domestic production and to unsettled conditions abroad.

## LETTER TO THE EDITOR

### Dilatometer for Heat-Sensitive Materials

SIR,—The method used by Bekkedahl and Wood (*Ind. Eng. Chem.* 1941, *33*, 381) is noted on p. 297 of your issue of May 24, as a novel procedure for sealing a heat-sensitive material by fusion in a glass tube without leaving a large free space. Precisely the same method was described in a paper on silver amalgams which I presented to the Institute of Metals just ten years ago. The description was as follows: "It was necessary to seal off the tube, but it was not possible to make the seal at a distance less than about 3 inches from the amalgam if undue heating of the latter by the blow-pipe flame were to be avoided. The large 'dead-space' which this procedure would otherwise have left above the specimen was reduced by the insertion of a closed tube B, also made from silica and fitting as closely as possible in the main container. The outer silica tube was finally filled with hydrogen and sealed off at A as shown in Fig. 1." (*J. Inst. Metals*, 1931, *46*, 509).—Yours faithfully,

Deptford, S.E.14. A. J. MURPHY.
May 26, 1941.

# New Control Orders

### Naphthalene

THE Secretary for Mines has, in pursuance of paragraph 3 of the Control of Coal Tar Order, 1941, issued a Direction in respect of naphthalene which will come into operation on June 9. Under the Direction, no "Distiller" or "Importer" may dispose of naphthalene except under the authority of a license. For a definition of "Distiller" or "Importer" *see* paragraph 11, S.R. and O. 1941, No. 81, Control of Coal Tar Order, 1941, dated January 20. For the purpose of the Direction naphthalene is defined as follows: "All grades of naphthalene having a melting point of 50° C. or higher."

### Central American Accounts

The Treasury announces the issue of the Regulation of Payments (General Exemptions) (No. 2) Order, 1941, and the Regulation of Payments (Central America) Order, 1941 (S.R. and O. 1941, Nos. 672 and 673) payments to Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama (excluding Canal Zone), Salvador, and Venezuela.

Payments to the above countries will henceforth be made in sterling to accounts entitled Central American Accounts. Such accounts will only be available for payments to the sterling area, except that payments may be made freely from any such Central American Account to any other Central American Account. All exports to these countries must be paid for in sterling from a Central American Account, or in dollars, or registered sterling.

### Antimony Imports

The Open General Licence permitting the importation of antimony ores, concentrates and residues, and antimony, crude and semi-manufactured, from the British Empire, Palestine and Transjordan, and Free French and Free Belgian territories has been revoked, as from May 19. Separate licences will not, however, be required for goods which are proved to have been dispatched to the U.K. before May 19, and are imported into this country before July 19, 1941.

# Chemical Matters in Parliament

### "Fire-Fighting" Chemicals

IN the House of Commons last week Mr. Ellis Smith asked the Home Secretary whether he was aware that advertisements were appearing in trade and industrial journals of proprietary liquids to be used for fighting incendiary bombs; whether he could give any guidance to the public as to which of these, if any, were of real use; and whether the purchase of such proprietary extinguishers by local authorities would rank for grant.

Mr. Mabane, Parliamentary Secretary, Ministry of Home Security, said he wished to acknowledge the assistance rendered by a large section of the Press in refusing to accept advertisements for commodities which might be harmful or of doubtful efficacy as compared with water. A number of proprietary chemical liquids were being sold, some at high prices. Many of them had been tested by the Research and Experiments Department of the Ministry of Home Security, but in no case had any been found which could be recommended in preference to water. Some of the liquids being sold were corrosive, some contained caustic substances dangerous to the eyes, and others produced fumes and smoke which might be harmful and which made fire-fighting difficult. Expenditure incurred on any such liquids would not be recognised for purposes of grant.

[*The policy of* THE CHEMICAL AGE *in this matter was clearly defined in the note entitled "$H_2O$ for Incendiary Bombs" in our issue of May 3, p.* 246.—Ed.]

### Dehydrated Foods

Mr. Wakefield asked the Parliamentary Secretary to the Ministry of Food whether he would consider increasing the import of dehydrated foods in order to save shipping space.

Major Lloyd George, replying, intimated that the possibility was constantly borne in mind, and experiments were now in progress from which useful results might be expected.

### Patents and Registered Designs

Sir Herbert Williams asked the President of the Board of Trade whether he would consider authorising a suspension of fees for patents and registered designs, which were temporarily rendered of little or no value on account of the Limitation of Supplies Order or the Concentration of Industry Scheme.

In reply Mr. Lyttelton said that he did not regard this proposal as practicable. As already explained, Section 18 of the Patents and Designs Act allows a patentee who has suffered loss by reason of hostilities to apply to the Court for an extension of the term of his patent. Where such an extension was granted, no renewal fees were charged.

# Mercury Consumption

### Record Figures in the United States

MERCURY production in the U.S.A. for January is reported as being about 3100 flasks, 600 less than in December. Domestic consumption rose from 2100 to 2900 flasks. Exports for January amount to 455 flasks, of which 326 went to the U.K. and 65 to Australia.

For February the production fell further to 2900 flasks, heavy rains in California having been reported as interfering with production. Consumption again rose, this time to 4700 flasks, a new monthly record, said to be chiefly due to consumption of the metal in the manufacture of mercuric oxide to satisfy recent naval purchases. Prices in February rose from $168-169 per flask at the start to $171-173 at the end of the month. Exports totalled 347 flasks, the U.K. taking 200 of these.

## MONTAN WAX SUBSTITUTE

A new synthetic wax called "Opalwax" is finding application in various industries in America as a substitute for montan and other formerly imported waxes. It is comprised principally of 12-hydroxy stearin (glyceryl trihydroxystearate) produced by the catalytic hydrogenation of castor oil, and combines unusual physical and chemical properties. It is practically odourless, pearl-white in colour, has an apparent specific gravity of 0.98 to 0.99 at 20° C., is very hard, and has an acid number of less than 2.0. The wax is extremely insoluble in the common solvents, but is dissolved, with severe discoloration, by concentrated sulphuric acid and is disintegrated and in part dissolved by concentrated nitric acid.

# Personal Notes

DR. DANIEL TYRER has relinquished his position with Messrs. Athole G. Allen (Stockton), Ltd., and is no longer a member of their Board of Directors.

DR. WILLIAM CULLEN was nominated as President-Elect of the Society of Chemical Industry at the recent meeting of Council, and DR. H. E. COX, DR. T. H. DURRANS, PROFESSOR J. C. PHILIP (retiring President), and COL. F. M. POTTER were nominated as vice-presidents to be elected at the annual meeting on July 8. MR. STANLEY ROBSON was appointed to fill the position of Hon. Foreign Secretary which would fall vacant by the elevation of Dr. Cullen to the presidency.

DR. CECIL H. DESCH, F.R.S., Past-President of the Institute of Metals, was awarded the Institute's platinum medal at the meeting of the Institute at Oxford last Wednesday. The three previous recipients of the medal were Sir William Bragg, F.R.S., Sir Harold Carpenter, F.R.S., and Dr. Paul D. Merica. Dr. Desch is also a past-president of the Faraday Society and vice-president of the Iron and Steel Institute. Since his retirement from the post of Superintendent of the Metallurgy Department of the National Physical Laboratory he has been Adviser to the Iron and Steel Council.

**Dr. C. H. Desch, F.R.S.**

MR. GORDON ROBBINS was unanimously nominated for the Presidency of the Institue of Journalists for 1942 at a general meeting of the members of the London District of the Institute held on Monday. Mr. Robbins is the Deputy Chairman and Editorial Director of Benn Brothers, Limited, the proprietors of THE CHEMICAL AGE, and was elected a Fellow of the Institute in 1920, when he was Day Editor of *The Times*. His father, Sir Alfred Robbins, and his brother, Mr. Alan Pitt Robbins, News Editor of *The Times*, filled the office of President in 1907 and 1935 respectively.

## OBITUARY

CAPTAIN P. MUSCHAMP, whose death at the age of 74 took place at Mansfield on May 21, was a director of the Welbeck Distillation Co., and a member of the Institute of Fuel. He was also a prominent figure in the coal-mining industry.

MR. EDWARD FRAY, who died recently at the age of 52, was chief works chemist at Elton Cop Dyeing Co., Ltd., Bury; he had occupied the post for 16 years. Previously he had been assistant works chemist at Mark Fletcher and Sons, Ltd., bleachers, Whitefield.

MR. HENRY LLOYD WILSON, who died at Clent, near Stourbridge on May 27, aged 79, had for many years been a chemical manufacturer in Birmingham. He served as chairman-secretary of the Society of Friends in Great Britain in 1904-10 and was a great supporter of charitable institutions in the Midlands.

MR. WALTER CURRIE, director until 1926 of John and James White, Ltd., has died at Grasse, France, aged 78. He joined the firm in 1884, and was appointed director when the concern became a private limited company in 1919.

MR. C. H. HEAP, whose death was recently reported, was dyestuffs adviser and secretary of the Dyestuffs Group of the Association of British Chemical Manufacturers. He was employed by Brotherton and Co., Ltd., until 1930, when he joined the Association's staff.

LORD AUSTIN died at Lickey Grange, near Bromsgrove, on May 23, aged 74. Although his name is associated principally with mechanical engineering, notably , of course, with the great motor car firm which bears his name, science in general owes him a great debt. He was always ready to help deserving causes, but his previous benefactions were overshadowed when, in 1936, he presented £250,000 to Cambridge University for the extension and further endowment of the Cavendish Laboratory. The work was put in hand under the guidance of the late Lord Rutherford, who was then Director of the Laboratory. Lord Austin's only son was killed in action in France in 1915.

DR. ARNOLD SCHEDLER, who died on May 20 at West Didsbury, Manchester, aged 68, was a director of the Clayton Aniline Co., Ltd., and Swiss consul in Manchester. He was one of the outstanding personalities in the dyestuffs industry in this country, and was particularly notable as an authority on the chemistry of azo dyestuffs. A native of Switzerland, and an alumnus of Basle University, Schedler was first employed by Gerber and Co., of Basle, a concern that was later absorbed by the Society of Chemical Industry in Basle. He remained with the latter company until his retirement in 1937, and before the outbreak of war in 1914 was transferred to the Clayton Aniline Co.'s works, which had been purchased by the Basle company in 1911. He was elected a director at Clayton in 1928, four years after he had been appointed Swiss consul in Manchester. He served on the Council of the Manchester Literary and Philosophical Society and, in 1933-35, was Chairman of the Manchester Section of the Society of Chemical Industry.

## A CHEMIST'S BOOKSHELF

EXPERIMENTS IN COLLOID CHEMISTRY. By E. A. Hauser, Ph.D., and J. E. LYNN, Sc.D. London: McGraw-Hill. Pp. 171. 14s.

The weakness of many degree courses in chemistry is the relative neglect of experimental work on colloids. Teachers are well aware that an ounce of practice is worth a pound of theory, but have been too ready to assume that a worth-while experimental course in colloid chemistry would involve prohibitive expenditure on apparatus. One of the merits of the work under review is that it disposes of the bogy of prohibitive cost. Compiled by two well-known American teachers of colloid chemistry, it embraces over 200 experiments of which a large number are particularly suitable for lecture demonstration and few of which entail anything in the nature of elaborate equipment.

A laboratory course based on this textbook would form an admirable corrective to many students who now run the risk of having their outlook dominated by the effort to acquire a more or less purely factual knowledge of chemistry. More than that, the work should be a source of inspiration to industrial chemists who are constantly facing problems involving surface phenomena, gelation, and other colloidal processes.

Telerecorder installations for the remote measurement of flows, pressures and levels consist of a transmitter, a mains unit and one or more receivers based on a simple voltmeter. A varied range of these instruments, manufactured by GEORGE KENT, LTD., Luton, Beds., is described and illustrated in their leaflet No. 808/441.

# General News——From Week to Week

SPECIMENS OF MONTGOMERYITE and sterretite, two new phosphate minerals, have been presented to the British Museum (Natural History) by Mr. A. Montgomery, of New York.

A CONTRIBUTION OF £20,000 was made to Widnes War Weapons Week on behalf of the Imperial Chemical Pensions Fund (I.C.I. General Chemicals, Widnes, Ltd.), a cheque for that amount being handed to the Mayor by two of the workers, Mr. W. Cohen and Mr. G. Leather.

A CIRCULAR LETTER sent by High Duty Alloys, Ltd., to their suppliers, outlines the procedure they have adopted to ensure prompt receipt of goods and invoices and quick payment of accounts in view of their having opened new branches in different parts of the country.

THE BOARD OF TRADE has, with the approval of the Treasury, decided that, in respect of the period beginning June 3 and ending September 2, 1941, the rate of premium payable under any policy of insurance issued under the Commodity Insurance Scheme shall continue to be at the rate of 7s. 6d. per cent. per month.

AT THE OXFORD MEETING of the Institute of Metals on May 28 an election of 16 new members was announced. Another election of members is due to be held on July 10, and members then elected will have the privilege of membership for a full year as the Institute's subscription period dates from July to June, 1942.

IT IS ANNOUNCED BY Adam Hilger, Ltd., of 98 St. Pancras Way, London, N.W.1, that a limited number of copies of Vols. I and II of *Tables of Refractive Indices*, compiled by R. Kanthack, and edited by J. N. Goldsmith, are available from the publishers at a reduced price (post free, 13s. and 15s. respectively).

THE BOARD OF TRADE has made an Order, the Limitation of Supplies (Miscellaneous) (No. 11) Order (S.R. and O. 1941 No. 700), regulating supplies of controlled goods during the quota period June 1 to November 30, 1941. The changes in the quota percentages have already been announced. These and the few other changes made by the new Order are explained in a memorandum, copies of which will shortly be obtainable from the Stationery Office. With the commencement of a new quota period on June 1, it is of special importance that in accepting orders for delivery in June, manufacturers and wholesalers should have regard to the distribution of population and should also aim at not supplying in the aggregate during the month more than one-sixth of their total quota.

## Foreign News

CANADIAN EXPORT PERMITS are not now required for export of fertilisers to the British Empire and the United States.

EXPORTS OF MEDICINAL BOTANICAL DRUGS, exclusive of camomile flowers, from Hungary to Britain in the year ending March 31, 1940, amounted to 126 metric tons, valued at 216,300 pengö.

A NEW INDUSTRY, for the production of cellulose by the chloride-alkaline process from various raw materials, including bagasse of sugar cane, esparto, banana stalks, and zacatón, has been exempted from taxation by a Mexican Government authorisation published on February 24. A period of 360 days is allowed before activities must commence.

DYESTUFFS FORMERLY IMPORTED into Canada from Europe are now being largely purchased in the United States, and this change of source has necessitated a wide range of new types and substitutes. Regular supplies of dyestuffs, however, are still being received from the United Kingdom, and present stocks are sufficient for some time. Prices of dyestuffs in Canada have advanced 35 per cent. over pre-war prices, largely through currency depreciation and increased import duties.

THE EXPORT OF CERTAIN CHEMICAL PRODUCTS and minerals from Brazil to countries other than those on the American continent, except under previous licence, has been prohibited. Included in the list of articles made subject to this control are aluminium, antimony, chromium, graphite, asbestos, tin, magnesium, quinine, vanadium, tungsten, petroleum products, nitric acid, anhydrides, copper, brass and bronze, zinc, nickel, potash and potash fertilisers.

A CONTRACT HAS BEEN SIGNED between Solvay Process, Hopewell, Virginia, and the U.S. War Department for the construction of an $11,000,000 anhydrous ammonia plant at Henderson, Kentucky, according to a report from New York. It is understood that arrangements have been made with T. V. A. for electric power.

INCLUDED IN THE BRITISH GOVERNMENT'S economic agreement with General de Gaulle's Council of Defence is an undertaking to purchase from French Equatorial Africa the total output of palm kernels, palm oil, ground nuts and beniseed. The agreement dates retrospectively to October 1, 1940, and holds good until September 30, 1941.

IMPORTS INTO PERU from the United Kingdom during the December quarter of 1940 were valued at 7,690,000 soles, compared with 4,024,000 soles in the corresponding period of 1939. Exports to the U.K. stood at 6,823,000 soles, as against 23,598,000 soles in the December quarter of 1939. Imports of chemical and pharmaceutical products rose from 6,315,000 to 7,888,000 soles.

THE GENERAL LEVEL OF WHOLESALE PRICES IN CANADA has risen 19.5 per cent. since the outbreak of war in Europe, the official index (1926 = 100) for August, 1939, being 72.4 as compared with 86.5 for the week ended April 18, 1941. The latest monthly index published was 85.2 for February. The index figures for iron and its products, non-ferrous metals, non-metallic minerals, and chemical and allied products show only slight changes in February compared with January.

THE AUSTRALIAN ALUMINIUM CO. is erecting plant at a cost of £500,000 on a 47-acre site at Granville, near Sydney, for aluminium production. Delay in reaching the production stage has been caused by the requisitioning, by the British Air Ministry, of much of the essential machinery for the Sydney factory. With little hope of having the English order repeated, the company had to order the machinery from American manufacturers, and already much of it is erected.

EXPANSION OF THE OUTPUT of natural gas, enormous reserves of which exist in the Soviet Union, is reported by the Moscow *Izvestia*. Petrol recovery from the gas is also part of the third five-year programme. Output has already increased sharply in the Azerbaijan fields, but much remains to be done in the way of eliminating waste and in providing adequate piping from the wells to the storage tanks. The establishment of gas-lift instead of air-lift pumping in deep wells is also contemplated.

## Forthcoming Events

THE CHEMICAL SOCIETY, Institute of Chemistry, and Society of Chemical Industry are holding a joint meeting on June 5 at 6.30 p.m. in the University Chemical Department (Woodland Road), Bristol, when Professor G. M. Bennett, M.A., Sc.D., F.I.C., will give a lecture-demonstration on "Liquid Crystals." All chemists who may be temporarily in the district are cordially invited to attend.

THE SOUTH WALES SECTION of the Society of Chemical Industry will hold its annual general meeting at the Philharmonic Hotel, St. Mary Street, Cardiff, on June 6, at 6.30 p.m.

THE CHEMICAL ENGINEERING GROUP of the Society of Chemical Industry and the Institution of Chemical Engineers are holding a joint meeting on June 10 at 2.30 p.m. in the rooms of the Chemical Society, Burlington House, Piccadilly, W.1, when a paper entitled "The Human Factor in Chemical Engineering Processes" will be presented by Dr. G. H. Miles. The lecturer has had extensive experience of the subject while with the National Institute of Industrial Psychology.

AT THE FORTHCOMING MEETING of the British Ceramic Society (Pottery Section), which will be held at the North Staffordshire Technical College, Stoke-on-Trent, on June 11, the following papers will be presented: "Improvements in Pottery Working Conditions," by Mr. T. Dymock (10.15 a.m.); and "Some Structures of Unfired Pottery Bodies Revealed by a New Technique," by Dr. W. O. Williamson (11.15 a.m.). For the afternoon a visit to the new works of Josiah Wedgwood and Sons, Ltd., at Barlaston, has been arranged.

# Weekly Prices of British Chemical Products

TRADE in general chemicals during the past week has followed pretty much the same course as of late, and the market displays no particular feature. So far as deliveries are concerned, fair quantities are going forward for immediate consumption, and there has been a steady flow of inquiry for new business. Practically all the soda products are strong, and for some items, such as chlorate of soda and yellow prussiate of soda, the demand is in excess of the supplies available, and these conditions also apply to the majority of potash products. An active inquiry is circulating for arsenic, formaldehyde, borax and acetone, and there is a brisk demand for tartaric and citric acids. Values generally are firm. A steady flow of business is reported from most sections of the coal tar products market, items such as carbolic acid, xylol, solvent and heavy naphthas and cresylic acid attracting fair attention, quotations for the last-named product being firm.

MANCHESTER.—Quotations continue steady to firm throughout the range of chemicals on the Manchester market, though the past week has witnessed few actual movements of any consequence. Sellers state that deliveries against existing commitments are being taken up reasonably satisfactorily on the whole, notwithstanding one or two relatively quiet spots, whilst some fair additions to order-books have been made. A scarcity of spot supplies in the potash products generally continues in evidence, and a shortage is also apparent in several other directions. Among the by-products pyridine is a shade dearer, whilst renewed firmness has been a feature of cresylic acid. For most of the tar products the demand is active.

GLASGOW.—In the Scottish heavy chemical trade there is no actual change from last week. Home and export trade keep steady with day-to-day transactions. Prices remain very firm.

## Price Changes

**Rises:** Antimony Sulphide, Creosote, Red Lead, White Lead, Xylol.

**Falls:** Copper Sulphate (MANCHESTER), India-rubber Substitutes.

## General Chemicals

**Acetic Acid.**—Maximum prices per ton: 80% technical, 1 ton £39 10s.; 10 cwt./1 ton, £40 10s., 4/10 cwt., £41 10s.; 80% pure, 1 ton, £41 10s.; 10 cwt./1 ton, £42 10s.; 4/10 cwt., £43 10s.; commercial glacial, 1 ton, £49; 10 cwt./1 ton, £50; 4/10 cwt., £51; delivered buyers' premises in returnable barrels, £4 10s. per ton extra if packed and delivered in glass.

**Acetone.**—Maximum prices per ton, 50 tons and over, £65; 10/50 tons, £65 10s.; 5/10 tons, £66; 1/5 tons, £66 10s.; single drums, £67 10s.; delivered buyers' premises in returnable drums or other containers having a capacity of not less than 45 gallons each. For delivery in non-returnable containers of 40/50 gallons, the maximum prices are £3 per ton higher. Deliveries of less than 10 gallons free from price control.

**Alum.**—Loose lump, £9 10s. per ton, d/d nominal.

**Aluminium Sulphate.**—£8 to £8 10s. per ton d/d.

**Ammonia Anhydrous.**—1s. 7d. to 2s. 2d. per lb.

**Ammonium Carbonate.**—£39 to £40 per ton d/d in 5 cwt. casks.

**Ammonium Chloride.**—Grey galvanising, £22 10s. per ton, in casks, ex wharf. Fine white 98%, £19 10s. per ton. MANCHESTER: Grey galvanising, £22 10s. per ton. See also Salammoniac.

**Antimony Oxide.**—£68 per ton.

**Arsenic.**—99/100%, about £31 10s. per ton, ex store.

**Barium Chloride.**—98/100%, prime white crystals, £11 10s. to £13 per ton, bag packing, ex works; imported material would be dearer.

**Bleaching Powder.**—Spot, 35/37%, £10 7s. 6d. per ton in casks, special terms for contract.

**Borax, Commercial.**—Granulated, £26; crystals, £27; powdered, £27 10s.; extra fine powder, £28 10s.; B.P. crystals, £35; powdered, £35 10s.; extra fine, £36 10s. per ton for ton lots, in free 1-cwt. bags, carriage paid in Great Britain. Borax Glass, lump, £73; powder, £74 per ton in tin-lined cases for home trade only, packages free, carriage paid.

**Boric Acid.**—Commercial, granulated, £42 10s.; crystals, £43 10s.; powdered, £44 10s.; extra fine powder, £46 10s.; large flakes, £55; B.P. crystals, £51 10s.; powdered, £52 10s.; extra fine powdered, £54 10s. per ton for ton lots in free 1-cwt. bags, carriage paid in Great Britain.

**Calcium Bisulphite.**—£6 10s. to £7 10s. per ton f.o.r. London.

**Calcium Chloride.**—70/72% solid, £5 15s. per ton ex store.

**Charcoal Lump.**—£10 10s. to £14 per ton, ex wharf. Granulated, supplies scarce.

**Chlorine, Liquid.**—£21 7s. 6d. per ton, d/d in 16/17 cwt. drums (3-drum lots); 5½d. per lb. d/d station in single 70-lb. cylinders.

**Chrometan.**—Crystals, 5½d. per lb.; liquor, £23 per ton d/d station in drums.

**Chromic Acid.**—1s. 2d. per lb., less 2½%; d/d U.K. GLASGOW: 1s. 0½d. per lb. for 1 cwt. lots.

**Citric Acid.**—1s. 2d. per lb. MANCHESTER: 1s. 6d.

**Copper Sulphate.**—About £29 10s. per ton f.o.b. MANCHESTER: £28 10s., less 2%, in 5 cwt. casks f.o.b. Liverpool.

**Cream of Tartar.**—100%, 252s. per cwt., less 2½%, d/d in sellers' returnable casks.

**Formaldehyde.**—£21 15s. to £25 per ton d/d. MANCHESTER: 40%, £22 to £25 per ton in casks d/d; imported material dearer.

**Formic Acid.**—85%, £47 per ton, for ton lots, carriage paid, carboys returnable; smaller parcels quoted up to 50s. per cwt., ex store.

**Glycerine.**—Chemically pure, double distilled 1260 s.g., in tins, £3 15s. to £4 15s. per cwt., according to quantity; in drums, £3 7s. 6d. to £4 1s. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

**Hexamine.**—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 1d. to 2s. 3d. per lb.; carriage paid for bulk lots.

**Hydrochloric Acid.**—Spot, 6s. 3½d. to 8s. 9½d. carboy d/d, according to purity, strength and locality.

**Iodine.**—Resublimed B.P., 9s. 11d. to 13s. 11d. per lb., according to quantity.

**Lactic Acid.**—Dark tech., 50% by vol., £31 per ton; 50% by weight, £38; 80% by weight, £67; pale tech., 50% by vol., £39 10s.; 50% by weight, £46, 80% by weight, £74. Not less than one ton lots ex works; barrels returnable, carriage paid.

**Lead Acetate.**—White, £46 10s. to £48 10s. ton lots. MANCHESTER: £46 to £48 per ton.

**Lead Nitrate.**—About £45 10s. per ton d/d in casks.

**Lead Red.**—English, 5/10 cwt., £43 10s.; 1 cwt. to 1 ton, £43 5s.; 1/2 tons, £43; 2/5 tons, £42 10s.; 5/20 tons, £42; 20/100 tons, £41 10s.; over 100 tons, £41 per ton, less 2½ per cent., carriage paid; non-setting red lead 10s. per ton dearer in each case.

**Lead White.**—Dry English, less than 5 tons, £55; 5/15 tons, £51; 15/25 tons, £50 10s.; 25/50 tons, £50; 50/200 tons, £49 10s. per ton, less 5 per cent., carriage paid; Continental material, £1 per ton cheaper. Ground in oil, English, 1/5 cwt., £63 10s.; 5/10 cwt., £62 10s.; 10 cwt. to 1 ton, £62; 1/2 tons, £60 10s.; 2/5 tons, £59 10s.; 5/10 tons, £57 10s.; 10/15 tons, £56 10s.; 15/25 tons, £56; 25/50 tons, £55 10s.; 50/100 tons, £55 per ton, less 5 per cent., carriage paid.

**Litharge.**—1 to 2 tons, £41 10s. per ton.

**Lithium Carbonate.**—7s. 9d. per lb. net.

**Magnesite.**—Calcined, in bags, ex works, £14 to £17 per ton

**Magnesium Chloride.**—Solid (ex wharf), £12 to £13 per ton MANCHESTER: £13 to £14 per ton.

**Magnesium Sulphate.**—Commercial, £10 to £12 per ton, according to quality, ex works.

**Mercury Products.**—Controlled price for 1 cwt. quantities: Bichloride powder, 11s. 7d.; bichloride lump, 12s. 2d.; ammon chloride powder, 13s. 5d.; ammon. chloride lump, 14s; mercurous chloride, 13s. 9d.; mercury oxide, red cryst., B.P., 15s.; red levig. B.P., 15s. 6d.; yellow levig. B.P., 14s. 9d.; yellow red, 14s. 4d.; sulphide, red, 12s. 11d.

**Methylated Spirit.**—Industrial 66° O.P. 100 gals., 2s. 0½d. per gal.; pyridinised 64° O.P. 100 gals., 2s. 5d. per gal.

**Nitric Acid.**—£23 to £31 per ton ex works.

**Oxalic Acid.**—From £60 per ton for ton lots, carriage paid, in 5-cwt. casks; smaller parcels would be dearer; deliveries slow.

**Paraffin Wax.**—Nominal.

**Potash, Caustic.**—Basic price for 50-100 ton lots. Solid, 88/92%, commercial grade, £53 15s. per ton, c.i.f. U.K. port, duty paid. Broken, £5 extra; flake, £7 10s. extra; powder, £10 extra per ton. Ex store, £3 10s. supplement.

**Potassium Bichromate.**—Crystals and cranular 7d. per lb.; ground 7d. per lb., carriage paid. MANCHESTER and GLASGOW: 7d. per lb. in orig. casks.

**Potassium Carbonate.**—Basic prices for 50 to 100 ton lots: hydrated, 83/85%, £46 17s. 6d. per ton; calcined, 98/100%, £52 10s. per ton, c.i.f. U.K. port. Ex warehouse, £3 10s. extra per ton.

**Potassium Chlorate.**—Imported powder and crystals, ex store London, 10d. to 1s. per lb.

**Potassium Iodide.**—B.P., 8s. 8d. to 12s. per lb., according to quantity.

**Potassium Nitrate.—Small granular crystals, £26 to £30 per ton ex store, according to quantity.**

**Potassium Permanganate.**—B.P., 1s. 5½d. per lb. for 1 cwt. lots; commercial, £7 9s. 6d. to £8 1s. 6d. per cwt., according to quantity d/d.

**Potassium Prussiate.**—Yellow, about 1s. 3d. to 1s. 5d. per lb., supplies scarce.

**Salammoniac.**—First lump, spot, £48 per ton; dog-tooth crystals, £50 per ton; medium, £48 10s. per ton; fine white crystals, £19 10s. per ton, in casks, ex store.

**Soda, Caustic.**—Solid, 76/77% spot, £14 17s. 6d. per ton d/d station.

**Soda Crystals.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.**

**Sodium Acetate.**—£37 to £40 per ton, ex wharf.

**Sodium Bicarbonate (refined).**—Spot, £11 per ton, in bags.

**Sodium Bichromate.**—Crystals, cake and powder, 5⅝d. per lb., anhydrous, 6d. per lb. net d/d U.K. MANCHESTER and GLASGOW: 5⅝d. per lb., in orig. casks.

**Sodium Bisulphite Powder.**—60/62%, £17 10s. per ton d/d in 2-ton lots for home trade.

**Sodium Carbonate Monohydrate.**—£21 per ton d/d in minimum ton lots in 2 cwt. free bags.

**Sodium Chlorate.—£36 to £45 per ton, d/d, according to quantity.**

**Sodium Hyposulphite.**—Pea crystals, £19 15s. per ton for 2-ton lots; commercial, £14 10s. per ton. MANCHESTER: Commercial, £14 10s.; photographic, £19 15s.

**Sodium Iodide.**—B.P., for not less than 28 lb., 9s. 6d. per lb.; for not less than 7 lb., 13s. 1d. per lb.

**Sodium Metasilicate.—£14 5s. per ton, d/d U.K. in cwt. bags.**

**Sodium Nitrate.**—Refined, £13 10s. per ton for 2-ton lots d/d

**Sodium Nitrite.—£22 to £23 per ton for ton lots.**

**Sodium Perborate.**—10%, £5 2s. per cwt.

**Sodium Phosphate.**—Di-sodium, £19 to £22 per ton d/d for ton lots. Tri-sodium, £25 to £27 per ton d/d for ton lots.

**Sodium Prussiate.**—From 7½d. per lb. ex store.

**Sodium Silicate.**—£8 17s. 6d. to £9 10s. per ton, for 4-ton lots.

**Sodium Sulphate (Glauber Salts).—£4 10s. per ton d/d.**

**Sodium Sulphate (Salt Cake).**—Unground. Spot £4 13s. 6d. per ton d/d station in bulk. MANCHESTER: £4 13s. 6d. per ton d/d station.

**Sodium Sulphide.**—Solid 60/62%, Spot, £17 5s. per ton d/d in drums; crystals, 30/32%, £12 12s. per ton d/d in casks.

**Sodium Sulphite.**—Anhydrous, £29 10s. per ton; Pea crystals, spot, £18 10s. per ton d/d station in kegs; commercial, £12 15s. per ton d/d station in bags.

**Sulphur.**—Finely powdered, £18 10s. per ton d/d; precip. B.P., 68s. per cwt.

**Sulphuric Acid.**—168° Tw., £6 10s. to £7 10s. per ton; 140° Tw., arsenic-free, £4 11s. per ton; 140° Tw., arsenious, £4 3s. 6d. per ton. Quotations naked at sellers' works.

**Tartaric Acid.**—3s. 0½d. per lb., less 5%, carriage paid for lots of 5 cwt. and upwards. MANCHESTER: 3s. 0½d. per lb.

**Zinc Oxide.**—Maximum prices: White seal, £30 17s. 6d. per ton; red seal, £28 7s. 6d. d/d; green seal, £29 17s. 6d. d/d buyers' premises.

**Zinc Sulphate.**—Tech., about £25, carriage paid, casks free.

## Rubber Chemicals

**Antimony Sulphide.**—Golden, 10d. to 1s. 10d. per lb. Crimson, 1s 8½d. to 2s. per lb.

**Arsenic Sulphide.**—Yellow, 1s. 9d. per lb.

**Barytes.**—Best white bleached, £8 3s. 6d. per ton.

**Cadmium Sulphide.**—5s. 6d. to 6s. 6d. per lb.

**Carbon Black.**—5½d. to 8½d. per lb., according to packing.

**Carbon Bisulphide.**—£33 5s. to £38 5s. per ton, according to quantity, in free returnable drums.

**Carbon Tetrachloride.—£46 to £49 per ton.**

**Chromium Oxide.**—Green, 1s. 6d. per lb.

**India-rubber Substitutes.**—White, 5 15/16d. to 8¾d. per lb.; dark, 5 9/16d. to 8½d. per lb.

**Lithopone.—30%, £25 per ton; 60%, £31 to £33 per ton.** Imported material would be dearer.

**Mineral Black.—£10 to £14 per ton.**

**Mineral Rubber, "Rupron."—£20 per ton.**

**Sulphur Chloride.—7d. per lb.**

**Vegetable Lamp Black.**—£45 per ton.

**Vermilion.**—Pale or deep, 13s. 8d. per lb., for 7 lb. lots and less.

**Plus 5% War Charge.**

## Nitrogen Fertilisers

**Ammonium Phosphate Fertilisers.**—Type A, £21 8s.; B, £15 5s. 6d., C, £18 17s. per ton in 6-ton lots, d/d farmer's nearest station up to June 30, 1941.

**Ammonium Sulphate.**—Per ton in 6-ton lots, d/d farmer's nearest station: March/June, £10 2s.

**Calcium Cyanamide.**—Nominal: supplies very scanty.

**Concentrated Complete Fertilisers.**—£15 10s. to £16 3s. 6d. per ton in 6-ton lots, d/d farmer's nearest station up to June 30, 1941. Supplies small except C.C.F. Special at £15 14s. per ton.

**"Nitro-Chalk."**—£9 14s. per ton in 6-ton lots, d/d farmer's nearest station up to June 30, 1941.

**Sodium Nitrate.**—Chilean, £13 10s. per ton in 2-ton lots, f.o.r. Liverpool, March delivery; agricultural, £10 14s. per ton in 2-cwt. bags, d/d farmer's nearest station up to June 30, 1941.

## Coal Tar Products

**Benzol.**—Industrial (containing less than 2% of toluol), 2s. to 2s. 2d. per gal., ex works.

**Carbolic Acid.**—Crystals, 9½d. to 10¾d. per lb.; Crude, 60's 3s. 3d. to 4s. 3d., according to specification. MANCHESTER: Crystals, 10½d. per lb., d/d; crude, 3s. 7d. to 3s. 10d. naked at works.

**Creosote.**—Home trade, 5½d. to 5½d. per gal., f.o.r., maker's works; exports 6d. to 6¼d. per gal., according to grade. MANCHESTER: 5½d. to 7¼ per gal.

**Cresylic Acid.**—Pale, 99/100%, 2s. 11d. per gal. MANCHESTER: Pale, 99/100%, 2s. 9d. per gal.

**Naphtha.**—Solvent, 90/160°, 2s. 4d. to 2s. 7d. per gal.; Heavy 90/190°, 1s. 8d. to 1s. 9d., naked at works. MANCHESTER 90/160°, 2s. 4d. to 2s. 7d.

**Naphthalene.**—Crude, whizzed or hot pressed, £14 per ton: purified crystals, £27 per ton in 2-cwt. bags: flaked, £27 per ton. Fire-lighter quality, £6 to £7 per ton ex works. MANCHESTER: Refined, £27 per ton.

**Pitch.**—Medium, soft, nominal, f.o.b. MANCHESTER: Nominal.

**Pyridine.**—90/140°, 17s. per gal.; 90/160°, 13s.; 90/180°, 4s. to 5s. per gal., f.o.b. MANCHESTER: 13s. 6d. to 17s. 6d. per gal.

**Toluol.—Pure, 2s. 5d., nominal. MANCHESTER: Pure, 2s. 5d. per gal., naked.**

**Xylol.**—Commercial, 3s. 6d. per gal.; pur, 3s. 9d. MANCHESTER: 3s. 4d. to 3s. 9d. per gal.

## Wood Distillation Products

**Calcium Acetate.**—Brown, £21 per ton; grey, £24. MANCHESTER: Grey, £23.

**Methyl Acetone.**—40.50%, £54 per ton.

**Wood Creosote.**—Unrefined, 2s. per gal., according to boiling range.

**Wood Naphtha, Miscible.—4s. 6d. to 5s. per gal.; solvent, 5s. per gal.**

**Wood Tar.**—£4 to £5 per ton, acording to quality.

## Intermediates and Dyes (Prices Nominal)

*m*-**Cresol** 98/100%.—Nominal.

*o*-**Cresol** 30/31° C.—Nominal.

*p*-**Cresol** 34/35° C.—Nominal.

**Dichloraniline.—2s. 8½d. per lb.**

**Dinitrobenzene.**—8½d. per lb.

**Dinitrotoluene.**—48/50° C., 9½d. per lb.; 66/68° C., 1s.

*p*-**Nitraniline.**—2s. 5d. per lb.

**Nitrobenzene.**—Spot, 5½d. per lb., in 90-gal. drums, drums extra, 1-ton lots d/d buyer's works.

**Nitronaphthalene.**—1s. 2d. per lb.; P.G., 1s. 0½d. per lb.

*o*-**Toluidine.**—1s. per lb., in 8/10 cwt. drums, drums extra.

*p*-**Toluidine.—2s. 2d. per lb., in casks.**

*m*-**Xylidine Acetate.—4s. 5d. per lb., 100%.**

## Latest Oil Prices

LONDON.—May 29.—For the period ending May 31, per ton, net, naked, ex mill, works or refinery, and subject to additional charges according to package and location of supplies:—LINSEED OIL, raw, £41 10s. RAPESEED OIL, crude, £44 5s. COTTONSEED OIL, crude, £31 2s. 6d.; washed, £34 5s.; refined edible, £35 12s. 6d.; refined deodorised, £36 10s. SOYA BEAN OIL, crude, £33; refined deodorised, £37. COCONUT OIL, crude, £28 2s. 6d.; refined deodorised, £31 7s. 6d. PALM KERNEL OIL, crude, £27 10s.; refined deodorised, £30 15s. PALM OIL, refined deodorised, £37; refined hardened deodorised £41. GROUNDNUT OIL, crude, £35 10s.; refined deodorised, £40. WHALE OIL, crude hardened, 42 deg., £30 10s.; refined hardened, 42 deg., £33. ACID OILS.—Groundnut, £19; soya, £17; coconut and palm kernel, £22 10s. ROSIN, 25s. to 30s. per cwt., ex wharf,, according to grade. TURPENTINE, 68s. 6d. per cwt. spot, American, including tax, ex wharf, in barrels, and ex discount.

LIVERPOOL, May 28.—TURPENTINE, spot, American, 68s. 6d. per cwt.

# Chemical and Allied Stocks and Shares

DESPITE no appreciable improvement of business in the stock and share markets, security values have been fairly well maintained on balance. Sentiment was assisted by President Roosevelt's speech and also by the latest war news, and under the lead of British Funds, the general undertone on the Stock Exchange became very firm. Subsequently, industrial shares were inclined to respond strongly in price on moderate demand, and small declines recorded earlier in the week were mostly regained.

At 30s. 9d. Imperial Chemical were unchanged on balance, and the 7 per cent. preference units were 34s., at which current yields compare satisfactorily with those obtainable on other leading industrial securities. B. Laporte were around 60s., at which the yield works out at only 5 per cent. on the basis of last year's 15 per cent. dividend, but the recently-issued results indicated that a dividend of fully 25 per cent. was earned on the shares. Fison Packard & Prentice remained at 32s., awaiting the interim dividend announcement, but were inactive, and at the time of writing, no dealings have been shown in Cooper, McDougall & Robertson ordinary, which, however, continued to be quoted at 20s. The financial results of the last-named company show the repetition of the dividend at 5 per cent., and the past year's profits recorded an improvement. The chairman's annual statement points out, however, that earnings cannot be expected to be maintained in view of increased taxation and a decrease in the livestock of certain countries, with the probable reduction in demand for some of the company's products.

Among other securities, British Oxygen have improved from 65s. to 66s. 3d., and British Match were better at 31s. 3d., compared with 30s. 6d. a week ago. Moreover, in response to hopeful dividend estimates current in the market, British Plaster Board continued to attract attention, and were higher at 14s. 6d. The units of the Distillers Co. were again favoured, and at 64s. 9d. recorded a rise of 1s. on balance. On the other hand, United Molasses had an easier appearance at 23s. 7½d., while Turner & Newall went back 9d. to 68s., and General Refractories were 7s. 10½d., compared with 8s. 1½d. a week ago.

Awaiting publication of the full financial results, Dunlop Rubber ordinary units were around 32s. 6d., and Borax Consolidated deferred units remained at 28s. The preferred ordinary and preference units of the last-named company appeared to attract somewhat more attention in view of the good yields shown at current prices. Courtaulds were reactionary at 30s. 3d., awaiting fuller details of the proceeds arising from the sale of the company's holding in the American Viscose Corporation. A good feature was provided by Wall Paper Manufacturers deferred units, which were 22s. 3d., compared with 21s. 9d. a week ago, while Pinchin Johnson improved from 18s. to 19s. Moreover, Nairn & Greenwich made the higher price of 53s. 9d., but pending the dividend announcement, Barry & Staines remained at 27s. At 22s. Lever and Unilever were a few pence better, and the various preference shares of the group were well maintained in price, while British Oil & Cake Mills prferred ordinary gained 6d. to 39s. 6d.

Cerebos were again quoted at £8. Owing to delay in completion of the accounts, the annual meeting of the last-named company will be held at a later date this year.

Only small movements were shown in Dorman Long, Stewarts & Lloyds and United Steel. Elsewhere, Boots Drug and British Drug Houses at 36s. and 23s. respectively, were quite well maintained, the last-named, on the repetition of the dividend at 6 per cent. Timothy Whites were 19s., and Sangers 15s. 1½d. Beechams Pills 2s. 6d. deferred shares were firmer at around 8s. 3d., pending the full results for the past financial year. "Shell" and other oil shares were reactionary at the beginning of the week, but later reflected the better tendency on the Stock Exchange.

# Company News

**British Drug Houses, Ltd.**, announce a net profit for 1940 of £70,148 (£85,151), and have declared a dividend of 6 per cent. for the year (same).

**John Knight, Ltd.** (Controlled by Lever Bros. and Unilever), announce a profit for 1940 of £141,022 (£197,962), and have declared an ordinary dividend of 10 per cent. (25 per cent.).

**Barry & Staines Linoleum, Ltd.**, report a final ordinary dividend of 7 per cent., making 10 per cent. for the year to January 31 (12½ per cent.). Profits, after allowance for taxation, were £107,899 (£161,329).

**Babcock and Wilcox, Ltd.**, have announced a net profit of £717,347 (£756,663), and a final ordinary dividend of 6 per cent., making 10 per cent. for the year (same), and bonus is repeated at 1 per cent.

**United Premier Oil & Cake, Ltd.**, record a net profit of £96,354 (£110,473), after allowing £154,200 for taxation (against £75,700). An ordinary dividend of 4d. a share is being declared, making 13⅓ per cent. (12½ per cent.).

**Cooper, McDougall and Robertson, Ltd.**, announce that a net profit of £112,219 (after allowing for tax) was earned in the year to September 30, against £116,404 in 1938-39. The ordinary dividend, already paid, is unchanged at 5 per cent., and the amount carried forward is £52,770.

**Goodlass Wall and Lead Industries, Ltd.**, report that after allowing £155,945 for tax, net profits for 1940 amounted to £109,845, as compared with £167,438 for 1939. An ordinary dividend of 6 per cent. is recommended, compared with a dividend of 6 per cent., and a bonus of 1 per cent. An amount of £79, 615 is carried forward.

The directors of the **Bradford Dyers' Association, Ltd.**, state that no decision has yet been arrived at for fixing a profit standard determining the basis of E.P.T. liability assessment. They are, therefore, unable to present the accounts for the year to December 31, 1940, at the meeting called for May 30. When the directors are in a position to submit the accounts they will call an extraordinary meeting for that purpose.

**B. Laporte, Ltd.** In last week's issue it was stated that the dividend recommended by this company on the new ordinary shares was at the rate of 7½ per cent. Actually, the dividend proposed for confirmation at the annual general meeting is at the rate of 10 per cent., per annum, on 42,150 new ordinary shares ranking for dividend from July 1, 1940, thus bringing the annual rate of dividend declared into line with that on the old ordinary shares.

# New Companies Registered

**Calder Bleaching Co., Ltd.** (367,281).—Private company. Capital: £1000 in 20,000 shares of 1s. each. Dealers in and bleachers of oils and fats, manufacturers and refiners of oil and oleaginous substances, etc. Directors: Fred Cockroft, Edgar V. Stones, Geo. E. Skinner and Geo. H. Coleman. Registered office: 14 Dock Street, Leeds, 10.

**Pal Chemicals, Ltd.** (367,210).—Private company. Capital: £1000 in 1000 shares of £1 each. Analytical chemists, chemical engineers, laboratory proprietors, manufacturers of chemical and industrial compounds, etc. Subscribers: Edwd. J. Crow, C. W. Roger. Solicitors: Theodore Goddard & Co., 10 Serjeants Inn, E.C.4.

**Urwin & Co., Ltd.** (367,215).—Private company. Capital: £12,000 in 12,000 shares of £1 each. Objects: to acquire the business of a manufacturing chemists carried on by Alfred Urwin. Directors: Alfred Urwin, A. A. Kirsop, Margaret M. Loughlin, Ann Hedley, Lily M. Oliver. Registered office: The Manors, Newcastle-on-Tyne.

**N.C.K. Products, Ltd.** (367,248).—Private company. Capital: £1000 in 1000 shares of £1 each. Manufacturers, importers and exporters of and dealers in glazes, lacquers, dyes, stains, paints, varnishes, abrasives, etc. Directors: Thos. S. Horan, Cyril A. Solly, C.A., Mrs. Barbara E. Carsten. Registered office: 109 Jermyn Street, S.W.1.

**British General Manufacturing Co. (1941), Ltd.** (367,241).—Private company. Capital: £750 in 750 shares of £1 each. Manufacturers of and dealers in chemicals, chemical engineering and other equipment, plant and accessories, etc. Directors: Ernest W. Geaves, Carl Fine, C.A. Secretary: E. W. Geaves. Registered office: 7 South Grove House, Highgate, N.6.

**Egyptian Chemical & Drug Industries, Ltd.** (367,286).—Private company. Capital: £10,250 in 10,250 shares of £1 each. Manufacturers, importers and exporters of and dealers in chemicals, pharmaceutical specialities, drugs, oils, soaps, etc. Directors: Sir Abdel Razak Abour Kheir Pacha, K.B.E., and Count Aziz de Saab. Solicitors: Field, Roscoe and Co., 64 Lincoln's Inn Fields, W.C.2.

THE CANADIAN MINISTER OF TRADE AND COMMERCE has issued consolidated and revised export permit regulations to be effective from May 5. These regulations, together with a list of articles for which an export permit is required, have been published in pamphlet form and are available through the Canadian Manufacturers' Association, Chambers of Commerce, Board of Trade and Customs Officers, or may be obtained direct from the Export Permit Branch, Department of Trade and Commerce, 116 Wellington Street, Ottawa.

EXPORTS OF FERTILISERS and fertiliser materials from the United States in February amounted to 94,316 long tons, valued at $1,289,231. Large increases were reported in shipments of phosphate rock and potash. The United Kingdom took most of the phosphate rock, the remainder going to Japan and South Africa. Japan took two-thirds of the month's exports of potash. Brazil was the largest customer for superphosphate. January-Febuary exports were nearly double those in the same period last year. Sharp declines in exports of nitrates were more than offset by increases in the phosphate and potash groups. Imports in February were comparatively low, totalling 97,677 long tons, with a valuation of $2,108,708.

# Inventions in the Chemical Industry

**The following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.**

## Applications for Patents

MANUFACTURE OF HYDROCHLORIC ACID.—H. Moore and F. Kind. 4838.

MANUFACTURE OF CASTINGS FROM METALS.—Phosphor Bronze Co., Ltd., W. Smithson and C. G. T. Hyslop. (March 18.) 4817.

MANUFACTURE OF CHLORINATED RUBBER.—Raolin Corporation. (United States, August 1, '40.) 4967.

MANUFACTURE OF SOLUTIONS OF POLYVINYL CHLORIDES.—Soc. des Usines Chimiques Rhone-Poulenc. (France, April 15, '40.) 4869.

DETERMINING THE PHOSPHATE CONTENT IN WATER.—J. Thompson (Kennicott Water Softeners), Ltd., and A. Klein. 4949.

FERMENTATION OF MOLASSES.—C. Weizmann. 4855.

FERMENTATION OF FERMENTABLE MATERIALS.—C. Weizmann. 4856.

FERMENTATION PROCESSES.—C. Weizmann. 4858.

FERMENTATIVE PRODUCTION OF MIXTURES OF FATTY ACIDS.—C. Weizmann. 4859.

UTILISATION OF WASTE LIQUORS.—C. Weizmann. 4860.

PRODUCTION OF ALIPHATIC KETONES.—C. Weizmann. 4866.

MANUFACTURE OF KETONES.—C. Weizmann. 4867.

PRODUCTION OF SATURATED KETONES.—C. Weizmann. 4868.

## Complete Specifications Open to Public Inspection

METHOD OF MANUFACTURING SYNTHETIC FIBRES from mixed polyvinyl alcohol with other materials.—Japan Institute for Chemical Fibres, Inc. Oct. 14, 1939. 10375/40.

MANUFACTURE OF ALIPHATIC AMINES.—Usines de Melle. Oct. 10, 1939. 12708/40.

MANUFACTURE OF SUBSTITUTED OR HALOGENATED META-DIOXANES. Standard Oil Development Co. Oct. 12, 1939. (Cognate application, 13789/40.) 13788/40.

CASTING OF VITREOUS MATERIAL.—British Thomson-Houston Co., Ltd. Oct. 13, 1939. 15143/40.

MANUFACTURE OF REFRACTORY ARTICLES.—Corning Glass Works. Oct. 11, 1939. 15164/40.

PROCESS FOR SEPARATION OF OLEFINES from mixtures of hydrocarbons.—Standard Oil Development Co. Dec. 29, 1938. (Divided out of 27826/39.) 4714/41.

## Complete Specifications Accepted

PROCESS FOR THE GRANULATION OF SUPERPHOSPHATE.—Silesia Verein Chemischer Fabriken. Aug. 15, 1938. 535,470.

TREATMENT OF GLYCERINE-CONTAINING MATERIALS.—W. J. Tennant (Armour and Co.). Sept. 7, 1939. 535,418.

COMPLEX PHENOLIC ESTER BASES AND SALTS THEREOF.—Resinous Products and Chemical Co. Nov. 12, 1938. 535,376.

PRODUCTION OF POLYAMIDES.—E. I. du Pont de Nemours and Co. Sept. 30, 1938. (Cognate application, 27003/39.) 535,421.

PRODUCTION OF ETHERS OF DIMETHYLOL UREA.—E. I. du Pont de Nemours and Co. Oct. 5, 1938. 535,378.

TREATMENT OF ARTIFICIAL FIBRES and like materials.—E. I. du Pont de Nemours and Co. Oct. 5, 1938. 535,379.

POLYMERISABLE COMPOUNDS.—W. W. Triggs (Röhm and Haas Co.). Oct. 6, 1939. (Convention date not granted.) 535,475.

INSECTICIDAL SPRAY COMPOSITIONS.—A. Abbey (Dow Chemical Co.). Oct. 6, 1939. 535,390.

MANUFACTURE OF BRANCHED-CHAIN PARAFFIN HYDROCARBONS.—Standard Oil Co. Dec. 14, 1938. 535,398

PROCESS FOR THE PRODUCTION OF PENTAERYTHRITE.—Lonza Elektrizitätswerke and Chemische Fabriken A.-G. Oct. 17, 1938. (Addition to 440,691.) 535,399.

PROCESS FOR THE MANUFACTURE of 2, 4-dioxo- 3, 3-dialkyl-pyrrolidines.—F. Hoffman-La Roche and Co. A.-G. Nov. 30, 1938. 535,430.

PROCESS FOR THE ISOMERISATION OF CHLOR-ALKANES.—J. G. Fife (N. V. de Bataafsche Petroleum Mij.). Nov. 27, 1939. 535,435.

PREPARATION OF LACQUERS containing melamine formaldehyde condensation products.—American Cyanamid Co. Dec. 31, 1938. (Cognate application, 32340/39.) 535,408.

NON-BITTER STARCH CONVERSION SUGAR PRODUCTS and process of manufacture.—J. F. Walsh, S. Kinzinger, A. H. Goodman, and American Maize-Products Co. Jan. 24, 1940. 535,448.

DEWAXING OF OILS.—Texaco Development Corporation. Feb. 11, 1939. (Cognate application, 1945/40.) 535,449.

PROCESS FOR DRYING GLUE.—E. H. Hoelscher, R. S. Tour, and Chemical Products Corporation. Feb. 12, 1940. 535,452.


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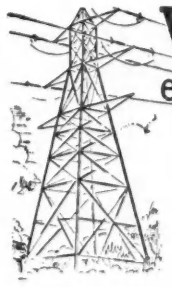

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